

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
24 December 2003 (24.12.2003)

PCT

(10) International Publication Number  
**WO 2003/107440 A3**

(51) International Patent Classification<sup>7</sup>: **H01L 33/00**,  
H01S 5/024, H01L 23/427

(21) International Application Number:  
PCT/GB2003/002431

(22) International Filing Date: 5 June 2003 (05.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0213504.4 13 June 2002 (13.06.2002) GB

(71) Applicant (for all designated States except US): **ENFIS, Limited** [GB/GB]; Technium, Kings Road, The Docks, Swansea SA1 8PH (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BOARD, Kenneth** [GB/GB]; 51 Westport Avenue, Mayals, Swansea

SA3 5EQ (GB). **EVANS, Gareth, Peter** [GB/GB]; 34 Hawthorne Avenue, Uplands, Swansea SA2 0LR (GB). **JONES, Gareth** [GB/GB]; 46, Heol Miskin, Pontyclun CF72 9AJ (GB).

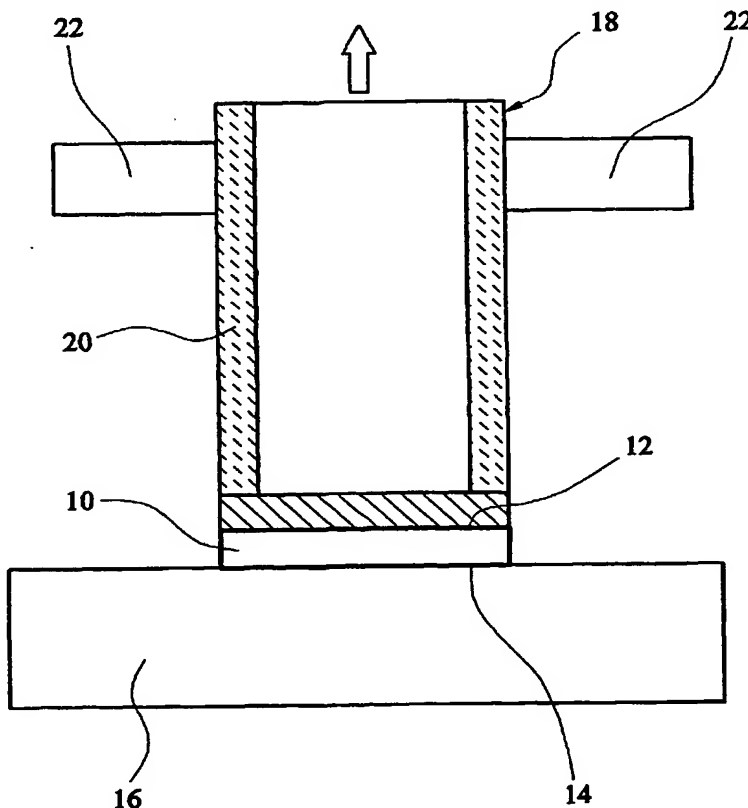
(74) Agent: **ABEL & IMRAY**; 20 Red Lion Street, London WC1R 4PQ (GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,

[Continued on next page]

(54) Title: OPTOELECTRONIC DEVICES



(57) Abstract: A light emitting semiconductor device (10) mounted on a heat sink (16) and having a heat pipe (18) located on its upper surface (12). The heat pipe (18) comprises a sealed cylindrical member of transparent or translucent material having a wick (20) disposed down the side and along the bottom thereof. The heat (18) is partially filled with a liquid which is placed under a partial vacuum to reduce its boiling point. A bundle of optical fibres may be provided within the heat pipe (18), with the gaps created between the optical fibres providing an efficient capillary action within the heat pipe (18) for transport of vapour to the cool end of the pipe (18) and for transport of condensed coolant to the hot end of the pipe (18).

WO 2003/107440 A3



ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(88) Date of publication of the international search report:  
5 August 2004

**Published:**

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 03/02431

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 H01L33/00 H01S5/024 H01L23/427

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H01L H01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 19, 5 June 2001 (2001-06-05) -& JP 2001 036153 A (MATSUSHITA ELECTRIC), 9 February 2001 (2001-02-09) paragraphs '0017!-'0020! ---	1-14
X	EP 0 658 933 A (SHARP KK) 21 June 1995 (1995-06-21) column 19, line 49 -column 21, line 47 ---	1-14
X	US 3 860 847 A (CARLEY J) 14 January 1975 (1975-01-14) column 2, line 35 -column 4, line 18 --- -/--	1-6,8-14



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

### \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

6 May 2004

Date of mailing of the international search report

17/05/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

van der Linden, J.E.

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 03/02431

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 004, no. 079 (E-014), 7 June 1980 (1980-06-07) & JP 55 046589 A (FUJITSU LTD), 1 April 1980 (1980-04-01) abstract	1-6,8-14
X	FR 1 428 845 A (THOMSON HOUSTON CO) 18 February 1966 (1966-02-18) page 2, left-hand column	1-6,8-14
X	GB 1 216 090 A (PHILIPS ELECTRONIC) 16 December 1970 (1970-12-16) page 3, line 50-119	1-3,5, 11-14
X	US 3 825 741 A (OLAND B ET AL) 23 July 1974 (1974-07-23) column 4, line 65 -column 5, line 27	1-3,5, 11-14
X	EP 0 789 405 A (TOYOTA MOTOR CO) 13 August 1997 (1997-08-13) page 3, line 47-56	1-3,5, 11-14
A	GB 1 295 775 A (RCA CORP) 8 November 1972 (1972-11-08) page 2, line 77 -page 4, line 89	1-7, 11-14
A	PATENT ABSTRACTS OF JAPAN vol. 009, no. 321 (E-367), 17 December 1985 (1985-12-17) & JP 60 153188 A (TOSHIKI SHINMURA), 12 August 1985 (1985-08-12) abstract	1,11-14
A	WO 99/16136 A (UNIV BRISTOL) 1 April 1999 (1999-04-01) page 13, paragraph 4 -page 14, paragraph 3	1,11-14
A	EP 0 435 473 A (DIGITAL EQUIPMENT CORP) 3 July 1991 (1991-07-03) the whole document	1,11-14
A	DATABASE WPI Section Ch, Week 198420 Derwent Publications Ltd., London, GB; Class J08, AN 1984-125544 XP002279226 -& SU 1 035 400 A (KURIKHIN V), 15 August 1983 (1983-08-15) abstract	8-10
P,X	US 2003/052584 A1 (NAGAI H ET AL) 20 March 2003 (2003-03-20) paragraphs '0087!-'0092!	1-3,5, 11-14

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 03/02431

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2001036153	A	09-02-2001	NONE	
EP 0658933	A	21-06-1995	JP 7170024 A JP 3074112 B2 JP 7335982 A DE 69428578 D1 DE 69428578 T2 EP 0658933 A2	04-07-1995 07-08-2000 22-12-1995 15-11-2001 27-06-2002 21-06-1995
US 3860847	A	14-01-1975	NONE	
JP 55046589 3	A		NONE	
FR 1428845	A	18-02-1966	NONE	
GB 1216090	A	16-12-1970	FR 1519635 A DE 1589274 A1 US 3508100 A	05-04-1968 05-03-1970 21-04-1970
US 3825741	A	23-07-1974	GB 1447677 A JP 50132935 A NL 7400580 A	25-08-1976 21-10-1975 09-09-1974
EP 0789405	A	13-08-1997	JP 9213980 A EP 0789405 A2	15-08-1997 13-08-1997
GB 1295775	A	08-11-1972	CA 926033 A1 DE 2015518 A1 FR 2042243 A5 JP 48022017 B	08-05-1973 15-10-1970 05-02-1971 03-07-1973
JP 60153188 3	A		NONE	
WO 9916136	A	01-04-1999	GB 2329756 A AU 9178398 A BR 9813223 A CA 2304166 A1 CN 1276917 T EP 1019970 A1 WO 9916136 A1 JP 2001517875 T	31-03-1999 12-04-1999 29-08-2000 01-04-1999 13-12-2000 19-07-2000 01-04-1999 09-10-2001
EP 0435473	A	03-07-1991	US 4995451 A DE 69031651 D1 DE 69031651 T2 EP 0435473 A2 JP 2080206 C JP 6021284 A JP 7112031 B KR 193331 B1	26-02-1991 04-12-1997 09-04-1998 03-07-1991 09-08-1996 28-01-1994 29-11-1995 01-07-1999
SU 1035400	A	15-08-1983	SU 1035400 A1	15-08-1983
US 2003052584	A1	20-03-2003	JP 2003092009 A	28-03-2003